44. Do you rent or do you own your home?

    Rent......... 28% (ASK 45)   26/

    Own.......... 70   (SKIP TO 46)

    Don't know... 1

    Refusal...... 1   (SKIP TO 47)

45. By any chance, do you expect to own your home within the next two or three years?

    Yes.......... 7% (ASK 46)   37/

    No........... 19

    Don't know... 2   SKIP TO 47)

46. Have you considered installing a solar energy system of any kind for your home in the next two or three years? (DO NOT READ LIST)

    Have already installed one....   1%   38/

    Definitely plan to install a
    system (i.e., have cost
    estimates, etc.)..............   5

    Have considered it, and may
    install one...................   16

    Have considered it, but will
    not install one...............   8

    Have not considered installing   69
    one...........................

    Not sure......................   1

47. According to what you have heard, read, or know from your own experience, how much opportunity does the Federal Government provide to citizens like you to express their views on environmental issues--a great deal, some, little, or none at all?

    A great deal........... 12%   39/

    Some................... 50

    Little................. 29

    None at all............ 21

    Depends (vol.)........   1

    No opinion.............   5

48. When people do express views on environmental issues, how much attention do you think the Federal Government gives to the views of individual citizens like you on environmental issues--a great deal, some, little, or none at all?

    A great deal........... 5   40/

    Some................... 31

    Little................. 59

    None at all............ 20

    Depends (vol.)........   3

    No opinion............   3

49. How much attention do you think the Federal Government gives to the views of environmental groups like the Sierra Club, the National Wildlife Federation or the National Audubon Society on environmental issues--a great deal, some, little or none at all?

    A great deal........... 20   41/

    Some................... 52

    Little................. 18

    None at all...........   4

    Depends (vol.)........   1

    No opinion............   6

50. How much confidence do you have that the Federal Government will provide sufficient protection for our natural environment--a great deal, some, a little, or none at all?

    A great deal...........13%   42/

    Some...................54

    Little.................25

    None at all........... 6

    Depends (vol.)......... 1

    No opinion............ 5

Page 10

51. How about energy? How much <u>confidence</u> do you have that the Federal Government will find a satisfactory ·
    to meet our future energy needs--a great deal, some, a little or none at all?

y

A great deal............	22%	42
Some....................	49
Little..................	18
None at all.............	7
Depends (vol.)..........	1
No opinion..............	3

52. All in all, from what you have heard or read, how safe are nuclear power plants that produce electric po·
    very safe, somewhat safe or not so safe?

Very safe...............	15%	4-
Somewhat safe...........	40
Not so safe.............	29
Dangerous (vol.)........	9
Not sure................	6
No answer	1

53. Here are a number of statements about different topics on which I would like to ask your opinion. Would you please indicate for each whether you agree strongly, agree, disagree or disagree strongly? (READ EACH ITEM)

	Strongly agree	Agree	Disagree	Strongly disagree	No opinion	
a. Technology will find a way of solving the problem of shortages and natural resources.............................	29%	53%	10%	3%	6%	45/
b. It seems like almost everything causes cancer; there is no point in trying to avoid specific chemicals or foods...	11	36	38	11	4	
c. An endangered species must be protected, even at the expense of commercial activity.................	22	51	18	2	-	
d. People would be better off if they lived a more simple life without so much technology......................	23	39	30	-	4	48/
e. Environmental problems are not as serious as some people would have us believe..............................	6	32	50	16	-	
f. I believe that plants and animals exist primarily for human use........	12	28	39	15	6	50/
g. Future scientific research is more likely to cause problems than to find solutions to our problems.......	8	22	42	12	12	51/

54. In recent years, the environmental movement has been very active. Do you think of yourself as: an active participant in the environmental movement, sympathetic towards the movement but not active, neutral, or unsympathetic towards the environmental movement?

        Active participant.......... ⁻% 52/
        Sympathetic, but not active. 55
        Neutral..................... 51
        Unsympathetic............... 1
        Not sure.................... 3

55. Now I am going to mention a number of things and ask whether you have done them in the past two years, that is during 1978 or 1979. First, by any chance have you had occasion to write a letter or contact a public official directly about an environmental matter or not?

        Yes.............. 12% (ASK 56)   53/
        No.............. 88
                          (SKIP TO 57)
        Can't recall....

56. Do you remember whether it supported or opposed greater environmental protection?

        Supported................... 9%   54/
        Opposed..................... 1
        Both (vol.)................. -
        Neither (vol.).............. -
        Can't recall................ 2

57. In the past two years have you ever collected newspapers or bottles for recycling?

        Yes............. 49%   55/
        No............. 50
        Can't recall....

58. What about boating, in the past two years have you gone sailing, canoeing, power boating, water skiing and the like?

        Yes............. 39% ASK 59)   56/
        No............. 60   (SKIP TO 61)
        Can't recall....

59. Was this within fifty miles of your home, or farther away, or both?

        Within 50 miles.............   57/

        Farther away................

        Both........................

        Can't recall................

60. [About how many times] have you [gone] boating [in] the past two years?

        Write in number:_____   58/

        Can't recall......

61. What about swimming, have you gone swimming in a freshwater lake or stream as opposed to a swimming pool or the ocean in the past two years?

        Yes........... 57% ASK 62)   60/
        No............. 63   (SKIP TO 64)
        Can't recall...

62. Did you go swimming in a freshwater lake or stream within fifty miles of your home, or farther away, or both?

        Within 50 miles........   61
        Farther away...........
        Both...................
        Can't recall...........

63. Roughly how many times have you gone swimming in a freshwater lake or stream over the past two years?

        Write in number:_____   62/63

        Can't recall.....

64. And last, have you gone fishing in a freshwater lake or stream in the past two years?

        Yes........... 34% ASK 65)   64/
        No............. 65   (SKIP TO 67)
        Can't recall...

65. Was this within 50 miles of your home, or farther away, or both?

        Within 50 miles........   65/

        Farther away...........

        Both...................

        Can't recall...........

66. Roughly how many times did you go fishing over the past two years?

        Write in number:_____   66/67

        Can't recall....

67. Now I am going to read you some phrases that describe different kinds of interests people have. As I read each one, would you please tell me whether it definitely applies to you, or only somewhat or not at all? (READ EACH ITEM)

	Definitely	Somewhat	Not at all	Not sure	
a. Someone who is anti-nuclear......................	20%	30%	44%	6%	68/
b. An environmentalist............................	18	55	24	3	69/
c. A cigarette or pipe smoker.....................	31	-	61	2	70/
d. Someone who keeps up with politics.............	28	52	20	1	71/
e. A hunter.......................................	10	8	81	1	72/
f. A backpacker and camper........................	15	18	65	1	73/
g. Someone who is pro-nuclear.....................	15	29	48	8	74/

68. Are you at present employed, either full time or part time?

Full time............ 51%   75/

Part time............ 9   (SKIP TO 70)

Not employed........ 40   (ASK 69)

69. Are you (call off appropriate categories):

Unemployed,.......... 3%   76/

(ASK 70)

Retired,............. 12

A housewife,......... 21

A student,.......... 3   (SKIP TO 73)

Or what? (all other). 1

70. What kind of work did you do in your job called? (WRITE IN RESPONDENT'S EXACT WORDS)

71. What do/did you actually do in that job? What were some of your main duties and responsibilities? (WRITE IN RESPONDENT'S EXACT WORDS)

72. What kind of an organization do/did you work for? (PROBE: What do they make; what do they do?) (WRITE IN RESPONDENT'S EXACT WORDS. BE SURE TO NOTE IF RESPONDENT IS AN EMPLOYEE OF GOVERNMENT AT ANY LEVEL, INCLUDING THE SCHOOL SYSTEM)

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40-3
```

73. Do you or does someone living here belong to a labor union?

        Yes, self a member............   15%   6/

        Yes, someone living here.....   14

        No...........................   70

        No response   2

                Yes...... 66%   7/

                No......   SKIP TO 78

75. What is the age of your youngest child?

        Record age: _____

76. What was the last grade of regular school that you completed--not counting specialized schools like secretarial, art or trade schools?

        No school..............

        Grade school (1-8).....   9%

        Some H.S. (9-11).......   16   SKIP TO 78

        H.S. Grad (12).........   38

        Some college (13-15)...   20

        College Grad (16)......   11   ASK 77

        Post Grad. (17+).......   6
        No response   1
77. Have you taken one or more courses for credit a a college or university in the past year?

                Yes........   11   11/

                No.........   24

78. Here is a list of age groups. HAND RESPONDENT CARD) Would you call off the letter by the age group you happen to be in? (IF REFUSED, INTERVIEWER ESTIMATE GROUP)

                                                12/
        a. 18-21............   8%

        b. 22-24............   8

        c. 25-29............   15

        d. 30-34............   11

        e. 35-39............   9

        f. 40-44............   6

        g. 45-49............   7

        h. 50-54............   7

        i. 55-59............   8

        j. 60-64............   7

        k. 65 or older......   15

79. Now here is a list of income categories. (HAND RESPONDENT CARD) Would you call off the letter of the category that best describes the combined annual income of all members of this household, including wages or salary, pensions, benefits, interest or dividends, and all other sources?

a. Under $4,000................... —%   11/

b. $4,000 to $5,999.............   —
                                              I
c. $6,000 to $7,999.............   5

d. $8,000 to $9,999.............   —
   ------------------------------------   ----------
e. $10,000 to $11,999..........   —
                                              II
f. $12,000 to $14,999..........   9
   ------------------------------------   ----------
g. $15,000 to $19,999..........   13
                                              III
h. $20,000 to $24,999..........   15
   ------------------------------------   ----------
i. $25,000 to $49,999..........   19
                                              IV
j. $50,000 and over............   3

Not sure/refused............. 10

```
┌─────────────────────────────────────────────────┐
│  NOW PROCEED ACCORDING TO INSTRUCTIONS IN SPECIAL NOTICE │
└─────────────────────────────────────────────────┘
```

F A C T U A L

Sex		Race		Hispanic origin	
Male.....47%	14/	White.............. 87% 15/		Yes....... 5%	16/
Female... 53		Black............. 12		No........ 87	
		American Indian or Alaskan native....			

Region

American Indian or Alaskan native....

Asian or Pacific Islander.........

New England	—%
Mid Atlantic	17
EN Central	17
WN Central	9
South Atlantic	17
ES Central	6
WS Central	9
Mountain	4
Pacific	13

```
┌──────────────┐
│ ID Cols.17-27 │
└──────────────┘
```

Size of Place

Central City 1 million	9%
& suburbs	9
250,000 - 1 million	13
& suburbs	11
50,000 - 250,000	14
& suburbs	14
Non-metro cities 10,000- 50,000	8
Smaller	22

```
┌────────┐
│ 30-4   │
└────────┘
```

SAMPLING PLAN FOR THE RFF SURVEY

Appendix V

The sampling frame for the survey is the adult civilian population of the continental United States, 18 years of age and older, exclusive of institutionalized segments of the population (armed forces installations, nursing homes, prisons, etc.).

The sampling plan was a multi-stage probability sample. The first stage of the sampling plan involved the selection of 100 counties at random proportions to the population after all the counties in the nation had been stratified by population size within geographic region, At the second stage, cities and towns within the sample counties were drawn at random proportionate to population. Where block statistics are available, blocks were drawn within the cities and towns at random proportionate to population. Where no block statistics are available, blocks or rural route segments were drawn at random.

Up to the point of drawing the block and route segments (clusters), the methodology employed is quite orthodox. From that point on, the sampling methodology employed is to our knowledge unique. The selected clusters (blocks and route segments) were divided into two matched and equal sized groups. One set of clusters was designated as "daytime" clusters, the other as "non-daytime" clusters. Interviewing in daytime clusters was conducted during weekday hours, Interviewing in on-daytime clusters was conducted in the evening (after 5:00 p.m.) or on weekends.

Since one-half of the clusters are limited to people at home more
than one-half of the daytime hours, and the other half of the cluster
limited to people <u>not</u> at home as much as one-half the daytime hours,
every conceivable kind of individual is properly accounted for in the one
set of clusters or the other. Once an eligible person was identified he
or she was interviewed at that time or, if not home, up to three call backs
were made.

Weighting procedures were used to bring the interviews into their
proper proportions according to family size and eligible households. Fol-
lowing this, the sample was sequentially weighted for sex, age, geographic
region and size of place. Despite the number of weights applied, the total
amount of weighting of a given interview is rather small, and the net
effect of the weighting produces only the most minor changes in results.

The statistical reliability of the results of questions for any given
demographic subgroup in the sample is a function of the <u>actual</u> number of
interviews obtained. However, the weight, or importance, or proportional
significance of any subgroup of the population in the total sample results
is a function of the weighted number of interviews. Another way of thinking
of the weighted interviews is that they are the number of interviews we
<u>should</u> have gotten if a uniform success rate had been obtained in completing
interviews with all demographic groups in the population. In practice,
the differences between the actual number of interviews obtained and the
number to which those who were interviewed were weighted are rather small
for any given subgroup, and hence we have confidence that little distortion
is introduced in the process of achieving a proper balance.

The response rate for this survey is 73 percent. This percentage was computed upon the number of interviews completed in households containing people eligible for an interview. The following table,provided by the Roper Organization, summarizes the statistics available from the interviewers' screening sheets.

Each interviewer's work was validated by an independent outside organization.

SAMPLE SUMMARY

	Total	Cluster	
		Evening/ weekend	Day- time
Total sample households	4297	2158	2139
Information households	3294	1610	1684
Households with eligible respondents	1860	975	885
One eligible respondent	1216	572	644
Two or more eligible respondents	644	403	241
No eligibie respondent	1434	635	799
Non-information households			
Total	1004	548	455
Refused enumeration	458	247	211
No contact	545	301	244

INTERVIEWS

	Total	Evening/ weekend	Day- time
Potential interviews			
Total	2504	1378	1126
From households with one eligible respondent	1216	572	644
From households with two or more eligible respondents	1288	806	482
Actual interviews			
Total	1580	854	726
with designated respondents	1364	728	636
With other eligibles in household	216	126	90

Appendix VI   CASES ELIMINATED FROM ANALYSIS

Observations were visually inspected for cases where the respondent showed gross inconsistency between his or her wtp amount and his or her answers to other relevant questions. A check was also made of the "real" ability of the respondent to pay the amount they gave. On the basis of these checks, twenty-two cases were eliminated.

- Fourteen of these cases represent people who gave zero or very low amounts relative to their income and yet who said in response to one question that pollution control was worth "any price" and in response to another question that they were willing to pay either higher prices or taxes for environmental improvement.

- Seven observations were deleted because their bids represent more than five percent of their income (in some cases as much as twenty percent). Our judgement here was somewhat tempered by the respondents water use and environmental views.

- One case was eliminated because the amount (zero) contradicted, in an extreme fashion, other views.

In all, less than 2% of the combined A, B, and C versions were dropped from the analysis. The amount given for level C and for response on eight additional relative variables are given below as well as the mean amount given for level C for these cases.

Variables

Level C   = Amount in dollars given for level C

INCOME   = Household income in dollars

AGECAT   = Age in categories with 1 = youngest; 11 = oldest

EDUC   = Highest level of school achieved

          1 = no schooling; 2 = grade school; 3 = some high school;

          4 = high school graduate; 5 = some college; 6 = college

          graduate; 7 = post graduate

VPOLCST   = View of pollution cost

          1 = prevent pollution at any cost; 2 = cost should be

          considered; 3 = already cost more than worth

CNPOLD   = Dummy for concern about water pollution

          1 = very concerned

NEITHERD = Dummy for not wanting to pay for pollution cost

          1 = not willing to pay; 0 = willing to pay either

          prices or taxes

ENVIST   = Self-identification as an environmentalist

          1 = definitely; 2 = somewhat; 3 = not at all

USERD   = Dummy for water use in last two years

          1 = water user

	LEVELC	INCOME	AGECAT	EDUC	VPOLCST	CNPOL	NEITHERD	ENVIST	USERD
1	0	37500	7	4	1	1	0	1	1
2	0	13500	3	3	1	1	0	1	1
3	0	37500	3	4	1	1	0	2	1
4	0	17500	2	5	1	2	0	2	1
5	0	37500	7	5	1	2	0	1	1
6	0	17500	1	5	1	1	0	1	1
7	0	37500	8	4	1	2	0	2	1
8	0	37500	4	7	1	2	0	2	1
9	0	22500	7	4	1	1	0	3	1
10	0	37500	1	5	1	1	0	2	0
11	0	22500	6	3	1	1	0	2	0
12	0	37500	2	5	1	1	0	1	1
13	0	9000	4	3	1	1	1	2	1
14	25	60000	2	5	1	2	0	2	1
15	125	60000	3	5	1	2	0	1	1
16	300	5000	11	6	2	2	1	3	0
17	505	2000	2	4	2	2	1	3	0
18	999	22500	2	4	2	2	0	2	1
19	999	5000	7	4	1	1	0	1	0
20	999	11000	4	4	1	1	0	1	1
21	999	17500	3	3	2	3	0	3	1
22	999	13500	3	5	1	1	0	2	1

Mean Level C for these 22 case = $271

Appendix VII   CONSTRUCTION OF ENVINDEX

        The environmentalist index (ENVINDEX) was developed from a series
of questions taken from the CEQ survey, The construction of ENVINDEX is
as follows:

```
        ENVINDEX = 0
        If  NEITHERD= 1 then ENVINDEX = ENVINDEX - 1
        If  POLLUTE = 1 then ENVINDEX = ENVINDEX - 1
        If  ENVMOVT = 4 then ENVINDEX = ENVINDEX - 1
        If  ENVIST  = 3 then ENVINDEX = ENVINDEX - 1
        If  VPOLCST = 3 then ENVINDEX = ENVINDEX - 1
        If  AIMCLEAN= 1 then ENVINDEX = ENVINDEX + 1
        If  ENVMOVT = 1 then ENVINDEX = ENVINDEX + 1
        If  ENVIST  = 3 then ENVINDEX = ENVINDEX + 1
        If  VPOLCST = 1 then ENVINDEX = ENVINDEX + 1
        If  LETTERD = 1 then ENVINDEX = ENVINDEX + 1
```

Where (a) NEITHERD (Q.38) is a dummy variable for the volunteered response
          of prefering not to pay high prices or taxes for environmental
          quality.

      (b) POLLUTE (Q.10) is a dummy variable for having chosen protecting
          nature against pollution as the respondents least favorite goal.

      (c) ENVMOVT (4.54) represents the respondents attitude towards the
          environmental movement: 1 - active participant; 4 - non-
          sympathetic.

      (d) ENVIST (Q.67b) is a question aksing for the respondents self
          identification as an environmentalist: 1 - definitely;
          3 - not at all

      (e) VPOLCST (9.34) is a question dealing with the tradeoff between
          environmental standards and cost: 1 - the extreme environmental
          standards at any cost; 3 - the position that environmental
          standards cost more than they are worth.

      (f) AIMCLEAN (4.2) is a dummy for having chosen protecting nature
          from being spoiled and polluted as one of the respondents aims.

      (g) LETTERD (4.55) is a dummy variable for having sent a letter or
          contacted an official on an environmental matter.

The Range of ENVINDEX is +5 to -5, with a distribution as follows:

```
        +5  -  1%      -1 - 17%
        +4  -  2       -2 -  9
        +3  -  6       -3 -  3
        +2  - 15       -4    1
        +1  - 21       -5    0
         0  - 25
```

Appendix VIII   A NEW CONSTRUCTIVE TEST FOR HETEROSKEDASTICITY

Richard T. Carson and William J, Vaughan

The ordinary least squares regression assumption of homoskedastic error terms is often untenable in empirical survey work. Heteroskedastic error terms cause parameter estimates to be inefficient (but still unbiased). A far more serious consequence of heteroskedasticity is that because the variance of the parameters (β_i) is biased, the associated t and F tests are also biased and may be potentially misleading. Heteroskedasticity can be expressed as:

$$(1)\quad \sigma_i^2 = \sigma^2 K_i$$

Where K_i is the functional form which the heteroskedasticity takes and the usual estimate of σ^2 is $E\varepsilon_{i(OLS)}^2$. Let us denote the matrix Ω^{-1} where Ω^{-1} is:

$$(2)\quad \Omega^{-1} = \begin{pmatrix} 1/K_i & 0 & . & . & . & . & . & . & 0 \\ 0 & 1/K_2 & & & & & & & 0 \\ . & & . & & & & & & . \\ . & & & . & & & & & . \\ . & & & & . & & & & 0 \\ . & & & & & . & & & \\ . & & & & & & . & & \\ 0 & 0 & . & . & . & . & 0 & K_n \end{pmatrix}$$

The appropriate generalized least squares (GLS) estimator of $\hat{\beta}$ is:

$$(3)\quad \hat{\beta} = (X'\Omega^{-1}X)^{-1} X'\Omega^{-1}y$$

and the correct estimate of the variance of is:

$$(4)\quad \text{var}\hat{\beta} = \sigma^2(X'\Omega^{-1}X)^{-1}$$

When $K_i = 1$ (for all i) equations (3) and (4) collapse to the OLS estimator, When K_i is known, the GLS estimate is straightforward.

In general, however, the functional form of the variance (K) is unknown and the true σ^2 is unobservable. A number of techniques have been suggested for estimating K. They may be classified into four general types.

A. Fixed coefficient functional forms

B. Grouping techniques

C. Maximum likelihood method

D. Flexible coefficient functional forms

We will discuss briefly each of these methods, noting their strengths and weaknesses, particularly with regards to survey research data. In the course of the discussion we will describe the procedures we applied to our benefits data and the results.

a. Fixed coefficient functional forms are the most commonly used heteroskedasticity correction method in survey research. Johnson (1972) suggests weighting by $1/X^2$ where there is unequal variance (of ε) with respect to X (usually income in consumer expenditure surveys). This weight matrix is used in equation 17 below. Golderberber (1964) has suggested that the variance will often be proportional to the predicted value which can be corrected for by weighting by $1/\hat{Y}^2$. This weight matrix is used in equation-18 below. A number of other fixed coefficient functional forms have been suggested (Maddala, 1977). This method is characterized by a need for _a priori_ specification of the functional form and its corresponding coefficients. The disadvantage of this method is that if the wrong weight matrix is used parameter estimates may become biased as well as inefficient (Malinvaud, 1980).

B. Grouping methods take two forms. Observations are either grouped on the basis of the value of the one of the variables (either independent or dependent) or on the magnitude of the OLS residuals. In the simplest case, t-tests are used to test the equivalence of the mean variance of the different groups. In more sophisticated cases a number of parametric and non-parametric tests have been used (Johnson, 1972; Goldfield and Quant, 1965). In general, if heteroskedasticity is present each group is weighted by $1/\sigma_i^2$ where i groups were used.

We see four main drawbacks to the grouping method of testing and correcting for heteroskedasticity: (1) Grouping methods based on one variable are unable to correct for complicated versions of heteroskedasticity which may extend to several variables; (2) Sophisticated programming techniques are necessary to implement some of the more complicated grouping techniques; (3) No information is given on the functional form of the heteroskedasticity; (4) In large surveys, a prohibitively large number of groups may need to be formed to adequately correct for heteroskedasticity.

C. Maximum likelihood methods specify the functional form of the Ω^{-1} and use maximum likelihood techniques to estimate the parameters in the equations. Maximum likelihood methods suffer from three drawbacks:

(1) They are difficult to program and not generally available
     for survey researchers.

(2) They require the functional form but not the coefficients to be known (Maddala, 1977; Goldfeld & Quant, 1972). This flexibility in estimating coefficients does, however, mean that approximations to a wide number of other functional forms can generally be achieved.

(3) Maximum likelihood estimators make very strong assumptions as to the normality of the error terms,

D. Flexible coefficient functional forms regress some form of OLS residuals on the independent variables of the original equation. If any of the parameters of this regression are significant, then heteroskedasticity is indicated. The coefficients of this regression are then used to construct the appropriate Ω^{-1} matrix. The two primary flexible coefficient functional form tests are: Glajser (1969) which uses $/\varepsilon_{(OLS}/$; modified Glajser (Goldfeld and Quant, 1972) which uses $\varepsilon^2_{i_{OLS}}$ and Park (Park, 1966; Dutta, 1975) which uses $\log(\varepsilon^2_{i_{OLS}})$. Glajser recommends using a number of functional forms to test for heteroskedasticity while Park recommends estimating:

$$(5) \quad \log\left(\sigma_i^2\right) = \alpha + \beta_1 \ln(X_1) + \beta_2 \ln(X_2) + \beta_n \ln(X_n) + v$$

where $\hat{\varepsilon}_{i_{(OLS)}}$ is an estimate of σ^2 and v is a well behaved error term.[1]
The appropriate weight is formed by taking the antilog of both sides of (5):

$$(6) \quad \sigma_i^2 = \sigma^2 X_i^{\beta_1} X_2^{\beta_2} \ldots X_n^{\beta_3}$$

---

[1] Goldfeld and Quant (1972) suggest that v is a poorly behaved error term in both the Glasier and Park test and that caution should be used in interpreting the significance levels of the coefficients.

It should be noted $\exp(\alpha)$ is an estimate of σ^2. Dividing both sides of equation (6) by $X_1^{\beta_1} X_2^{\beta_1} \ldots X_n^{\beta_1}$ results in:

(7)
$$\frac{\sigma^2}{X_1^{\beta_1} X_2^{\beta_2} \ldots X_n^{\beta_n}} = \sigma^2$$

Park states that this is a very flexible functional form which can approximate most forms of heteroskedasticity and should be used unless a priori knowledge suggests an alternative form.

The obvious problem with the Park test is that it cannot be used with dummy variables since the log of zero is undefined. To overcome this difficulty we modified the Park test in the following fashion:

(8) $\ln\left(\sigma_i^2\right) = \alpha + \beta_1 \ln X_1 \ldots + \beta_k \ln X_k + \beta_{k+1} \ln D_{k+1} \cdots$

$+ \beta_n \ln D_n + v$

where X_i represents a continuous variable and D_i represents a dummy variable.

The appropriate weight is now:

(9)
$$\frac{\sigma_i^2}{X_1^{\beta_1} \ldots X_k^{\beta_k} \exp(\beta_{k+1} D_{k+1}) \ldots \exp(\beta_n D_n)} = \sigma^2$$

The GLS results of this weight matrix are shown in equation (16) (below). Applying this modified Part test to the residuals from equation (15) we found that heteroskedasticity was still present although greatly reduced. This construction is awkward since it posits different functional forms for the variance with respect to continuous and dummy variables.

Our construction of the weight matrix in the modified Park test led us to believe that a semilog functional form would produce many of the same desirable properties of the Park test. This new test overcame some of the difficulties of the modified Park test by positing the same functional form with respect to both continuous and dummy variables, This new test regresses log (ε^2) on the unlogged variables of the original equation (in our case, eq. 14 below). Thus, this is a semilog constructive test for hetero-skedasticity. The test is shown in equation 10 below:

$$(10) \quad \ln(\sigma^2) = \alpha + \beta_1 X_1 \ . \ . \ + \beta_k X_k + \beta_{k+1} D_{k+1} \ . \ . \ + \beta_n D_n + v$$

Taking the antilogs of both sides

$$(11) \quad \sigma_i^2 = \exp(\alpha \ + \beta_1 X_1 \ . \ . \ + \beta_k X_k + \beta_{k+1} D_{k+1} \ . \ . \ \beta_n D_n)$$

Dividing both sides by $\exp(\beta_1 X_1 + \beta_k X_k \ . \ . \ . \ \beta_{k+1} D_{k+1} + \ . \ . \ \beta_n D_n)$

$$(12) \quad \frac{\sigma_i^2}{\exp(\beta_1 X_1) \ ... \ \exp(\beta_k X_k) \exp(\beta_{k+1} D_{k+1}) \ ... \ \exp(\beta_n D_n)} = \sigma^2$$

This test can be easily implemented on a number of standard statistical computer packages.[2]

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[2]The test and correction can be done in one program with a few steps in SAS. Implementation in BMDP is straightfoward and is possible but difficult for SPSS. The SAS program is available through Richard Carson Charles Paulsen at Resources for the Future.

Equation (13) shows the results of implementing equation (10) on the OLS residuals from our data for level C (equation 14).

Mode 101 → Equation 13

RSEMIL → $\ln(\hat{\epsilon}^2_{OLS})$

The t-statistics indicate that heteroskedasticity was present, especially with respect to income, but also very significantly on a number of other variables including the dummy variable for concern about water pollution

Table 1 presents our original OLS results and those obtained from several methods of correcting for heteroskedasticity. Taking our semilog test (e.g. 15) as being correct;[3] the modified Park (e.g. 16) was fairly successful but placed slightly too much significance on income and distorted the parameters of the two dummy variables; weighting by $1/\text{Income}^2$ (e.g. 17) was also fairly successful but distorted the significance of income level downward; weighting by $1/\hat{Y}^2$ (e.g. 18) produced what could only be termed very distorted coefficients and a bizarre t statistic on the age variable.

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[3]To establish this with certainty, extensive sampling experiments would have to be done.

COMPARISON ORIGINAL OLS OF ESTIMATION WITH FOUR CORRECTIONS

FOR HETEROSKEDASTICITY

Dependent Variable: WTP for Fishable Water Quality Nationally

Parameter	OLS eq. 14		Semilog eq. 15		Modified Park eq. 16		$1/income^2$ eq. 17		$1/\hat{Y}^2$ eq. 18	
	coefficient (t)								.	
Intercept	-163.831	(-3.03)	-25.632	(.80)	-7.073	(-.23)	-5.310	(-.22)	218.895	(17.08)
INCOME	.00721	(10.95)	.00582	(9.06)	.00584	(10.44)	.005616	(7.29)	.00479	(7.99)
AGE	-1.844	(-3.25)	-1.481	(-4.56)	-1.431	(-4.52)	-1.337	(-5.20)	-3.991	(-27.09)
EDUC	15.148	(2.04)	10.373	(2.25)	10.390	(2.31)	10.147	(2.82)	-4,585	(-3.23)
ENVINDEX	28.742	(5.40)	11.041	(3.63)	9,046	(3.28)	9.027	(3.98)	-3.792	(-1.71)
CWPOLD	51.178	(2.84)	34.298	(2.97)	28.995	(2.69)	25.240	(3.10)	81.985	(16.73)
USERD	40.876	(2.20)	32.918	(7.07)	29.527	(2.89)	33.788	(3.97)	25.111	(5.19)